

## REPORT DOCUMENT

Form Approved  
OMB No. 0704-0188

AD-A227 452

1a. REPORT SECURITY CLASSIFICATION  
UNCLASSIFIED2a. SECURITY CLASSIFICATION AUTHORITY  
N/A2b. DECLASSIFICATION/DOWNGRADING SCHEDULE  
N/A4. PERFORMING ORGANIZATION REPORT NUMBER  
N/A

DISTRIBUTION UNLIMITED

6a. NAME OF PERFORMING ORGANIZATION  
DEFENSE MAPPING AGENCY6b. OFFICE SYMBOL  
(If applicable)  
PA7a. NAME OF MONITORING ORGANIZATION  
DMA Hydrographic/Topographic Center6c. ADDRESS (City, State, and ZIP Code)  
8613 Lee Highway  
Fairfax, VA 22031-21377b. ADDRESS (City, State, and ZIP Code)  
6500 Brookes Lane  
Washington, D.C. 20315-00308a. NAME OF FUNDING/SPONSORING  
ORGANIZATION  
DMAHTC8b. OFFICE SYMBOL  
(If applicable)  
PR9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER  
N/A8c. ADDRESS (City, State, and ZIP Code)  
6500 Brookes Lane  
Washington, D.C. 20315-0030

10. SOURCE OF FUNDING NUMBERS

PROGRAM  
ELEMENT NO.  
N/APROJECT  
NO.  
N/ATASK  
NO.  
N/AWORK UNIT  
ACCESSION NO.  
N/A11. TITLE (Include Security Classification)  
MARITIME SAFETY INFORMATION IN THE YEAR 2000: LISTEN UP, NAVY, THE TIMES THEY  
ARE A CHANGIN'!12. PERSONAL AUTHOR(S)  
HALL, STEVEN C.13a. TYPE OF REPORT  
Individual Study Proj.13b. TIME COVERED  
FROM N/A TO14. DATE OF REPORT (Year, Month, Day)  
90 02 2315. PAGE COUNT  
24

## 16. SUPPLEMENTARY NOTATION

Individual Military Study Project intended for publication. Prepared at the US Army War College, 1989-1990.

## 17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)  
INMARSAT, SafetyNET, Navigational Safety, Maritime Telecommunications, GMDSS, NAVTEX, Worldwide Navigational Warning Service.

## 19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Maritime safety information is that special category of navigational safety data that warns mariners at sea of hazards to navigation, which might be encountered while underway. It does the most good when received before the hazard is encountered. The U.S. Navy pioneered the use of radio to transmit maritime safety information to ships at sea beginning in 1908. Over the years, they have relinquished this position as a leader and become a follower. Beginning in 1992, the commercial maritime world will step out ahead of the U.S. Navy using modern commercial communications technology. Unless Navy reconsiders its position on receiving maritime safety information using NAVTEX and SafetyNET, it will remain a follower and be seriously disadvantaged. The risk here is not in losing a race, but in losing a ship.

## 20. DISTRIBUTION/AVAILABILITY OF ABSTRACT

☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

## 21. ABSTRACT SECURITY CLASSIFICATION

UNCLASSIFIED

## 22a. NAME OF RESPONSIBLE INDIVIDUAL

STEVEN C. HALL

## 22b. TELEPHONE (Include Area Code)

717-249-9466

## 22c. OFFICE SYMBOL

PR

MARITIME SAFETY INFORMATION IN THE YEAR 2000:  
LISTEN UP, NAVY, THE TIMES THEY ARE A CHANGIN'!

by  
Steven C. Hall

INTRODUCTION

Ever since man has gone down to the sea in ships, it has been his desire to know what lay ahead before he stood into danger. This need to know applies to military combatants as well as to merchant vessels. Historically, governments have been relied upon to furnish timely navigational safety information to ships to promote safety of life at sea.

Avoiding disaster at sea has long been a problem of time versus available means of communications. The United States (U.S.) began winning this battle against the clock in 1908. That was the year the U.S. Navy (USN) started radio transmission of navigational warning information to ships at sea.<sup>1</sup> Since this was a humanitarian undertaking, such warning transmissions were provided on open public broadcasts for the benefit of mariners in general, regardless of nationality.

However, due to its military mission, the Navy gradually moved away from relying on its own public broadcasts. Instead, it began using independent U.S. Department of Defense (DoD) supported communications systems. When this separation of systems

was completed, the Navy lost sight of the source of Maritime Safety Information (MSI).

Technology now has taken a giant step forward in the area of MSI dissemination. NAVTEX and SafetyNET\* will soon be realities. These new MSI systems are going to leave the Navy far behind the power curve. The Navy should reexamine its position and take advantage of NAVTEX and SafetyNET. Failure to do so may place its ships unnecessarily at risk around the world.

This paper will review the history of MSI broadcasts. It will then describe the dilemma the USN will soon face. A recommended solution to this circumstance is also presented.

#### 1908 - 1977 RADIO GOES TO SEA

The U.S. began transmitting navigation safety warning information to ships at sea in 1908. The Navy collected the data and composed the messages. It operated radio equipment to communicate with ships at sea by Morse code. These broadcasts were on an unscheduled basis at that time; that is, they were made as needed.

The TITANIC disaster in 1912 resulted in emphasis being placed on the use of radio at sea in two major areas. First, it was agreed internationally that certain types of ships must carry

\* SafetyNET is a registered trademark of the International Maritime Satellite Organization (INMARSAT).

By _____	
Distribution/	
Availability Codes	
Dist and/or	
Dist	Special
A-1	

radio equipment to be warned of hazards to navigation while at sea. Second, it led to establishing the International Ice Patrol. The Ice Patrol produced ice warnings which were broadcast by radio.

Steady improvements to the broadcast system and equipment were made. By 1922, the volume of necessary navigation safety warnings justified scheduled broadcasts by U.S. Navy radio stations from both the East and West Coasts of the U.S.<sup>2</sup> Other maritime nations around the world were operating similar radio warning systems concurrently. The capability to warn ships at sea before they hit the iceberg, the uncharted reef, or the newly sunken wreck had finally arrived.

The responsibility for transmitting MSI in the United States rested initially with the U.S. Navy Hydrographic Office. This organization became the U.S. Naval Oceanographic Office (USNOO) in 1962. In 1972, the U.S. Defense Mapping Agency Hydrographic Center (DMAHC) assumed operational control of this traditional Navy function.<sup>3</sup> Since 1978, the U.S. Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC) has exercised these functions for the benefit of all ships, military or civilian. DMAHTC is responsible for deep sea or long range warnings while the USCG produces warnings for the sea coasts of the United States. These missions are complementary and often use the same communications equipment. This cooperation between the USCG and the DoD gives the United States a truly comprehensive, worldwide radio navigation warning system.

During the developmental period, USN civilian personnel of the USNOO processed incoming navigational safety information from a variety of domestic and foreign sources. Finalized warning messages were forwarded to USN communications facilities. Upon receipt, these data were treated in two separate ways. First, they were transmitted by Morse code to commercial shipping around the world on scheduled broadcasts. Second, the information was edited, reformatted, and grouped according to the mission or area of operation of particular Navy ships. These data were now transmitted on special Navy communications circuits.

It was only natural that as sophisticated equipment came on line to satisfy military requirements, the Navy would use it to service its own ships with MSI. The Navy took advantage of narrow band direct printing (NBDP) technology and satellite communications long before the civilian community. These new methods of communication were beyond the economic reach of most of the commercial maritime entities at that time. Therefore, public broadcasts containing warning information continued to be keyed separately in Morse code.

This gravitation by the Navy to its own communications equipment and methods marked the beginning of the end of the Navy's leadership role in MSI dissemination. The end was complete when the DMAHC assumed these broadcast functions in 1972.<sup>4</sup> The very same civilian personnel continued to process navigational warnings; however, they now worked for DoD rather than the Department of the Navy. The Navy no longer took part in MSI

policy formulation, having relinquished that function to DMA and the USCG.

As the U.S. developed its worldwide MSI capability, several other major maritime nations did likewise. The United Kingdom, France, and the Soviet Union established worldwide coverage. Japan, India, Germany, Spain and many others operated more localized, national systems. It was these foreign national systems that provided the source material for most U.S. long range broadcast warnings. The sources of the remainder of these data were the USCG, the U.S. Department of State (DoS), and other government agencies. Direct reports from ships at sea of hazards to navigation also contributed.

Up until 1977, the U.S. radio broadcast warning system contained three types of warnings. Coastal warnings were broadcast by the USCG by voice and Morse code. They covered waters within about 250 miles of the coast. Long range MSI was transmitted by USN and USCG radio stations by Morse code. Radio warnings for the Atlantic Ocean were called HYDROLANTs (Hydrographic Warnings-Atlantic). Those for the Pacific and Indian Oceans were called HYDROPACs (Hydrographic Warnings-Pacific). These messages were originated by DMA. SPECIAL WARNINGS (originated by DoS) were transmitted over both the coastal and long range radio warning systems. All these warnings continued to be transmitted to the civilian mariner primarily by Morse code, just as they were in 1908.

## 1977 - A TIME OF TRANSITION

On 1 January 1977, the U.S. commenced conditional participation in the internationally supported Worldwide Navigational Warning Service (WWNWS).<sup>5</sup> The DMA and the USCG were principal architects in the design of this system. The WWNWS was created under the auspices of the International Maritime Organization (IMO) and the International Hydrographic Organization (IHO)<sup>6</sup> following ten years of discussion. It had three goals; namely, to eliminate redundant warnings worldwide, to standardize format and content of messages, and to improve broadcast warning efficiency by taking advantage of new technologies.<sup>7</sup>

The WWNWS divided the maritime world into sixteen navigational warning areas or NAVAREAS as shown by Figure 1. The intent was that each NAVAREA would have a coordinator responsible for obtaining broadcast warnings from national coordinators within the NAVAREA. The coordinator would broadcast these data on scheduled transmissions. This arrangement reduced the size of areas of geographic responsibility to manageable levels. It replaced multiple worldwide coverage systems with a single, cooperative, coordinated worldwide operation. By eliminating redundancy and message reprocessing, it improved delivery time.

The Navy, not wishing to lose custom tailored worldwide coverage, requested that the U.S. Government maintain the HYDROLANT/HYDROPAC system. A compromise was reached. The limits of the existing HYDROLANT and HYDROPAC coverage areas were

reduced to accommodate NAVAREAS IV (Atlantic) and XII (Pacific).<sup>9</sup> The DMAHTC became coordinator for these two NAVAREAS. HYDROLANTs and HYDROPACs still cover the remaining fourteen foreign NAVAREAS. See Figure 2.

This compromise allowed the Navy to receive worldwide coverage of MSI without using the NAVAREA system directly. NAVAREA IV and NAVAREA XII messages, combined with HYDROLANTs and HYDROPACs, covered the world. The latter two categories, however, were not nearly as timely as the originating foreign NAVAREA broadcasts.

#### PRESENT DAY CONCERNS

To continue the HYDROLANT/HYDROPAC system, the DMAHTC made arrangements to receive messages from the other fourteen NAVAREA coordinators. Most of these data are received electronically. Unfortunately, some arrive by mail. Incoming messages are evaluated, reformatted as HYDROLANTs, HYDROPACs, or NAVAREA warnings, and transmitted to USN communications stations. Upon receipt, they are again reformatted and transmitted to commercial shipping on public broadcasts and to the Navy ships by separate means. Each time a message is recomposed, time is lost and errors can be introduced. The HYDROLANT/HYDROPAC system serves well as a back up to the NAVAREA system, but only as a back up. This duplicate, inferior, and less timely message system continues to service the Navy.

For many years, the Navy used radio teletype to minimize



# NAVAREA—RADIO NAVIGATIONAL WARNING SYSTEMS

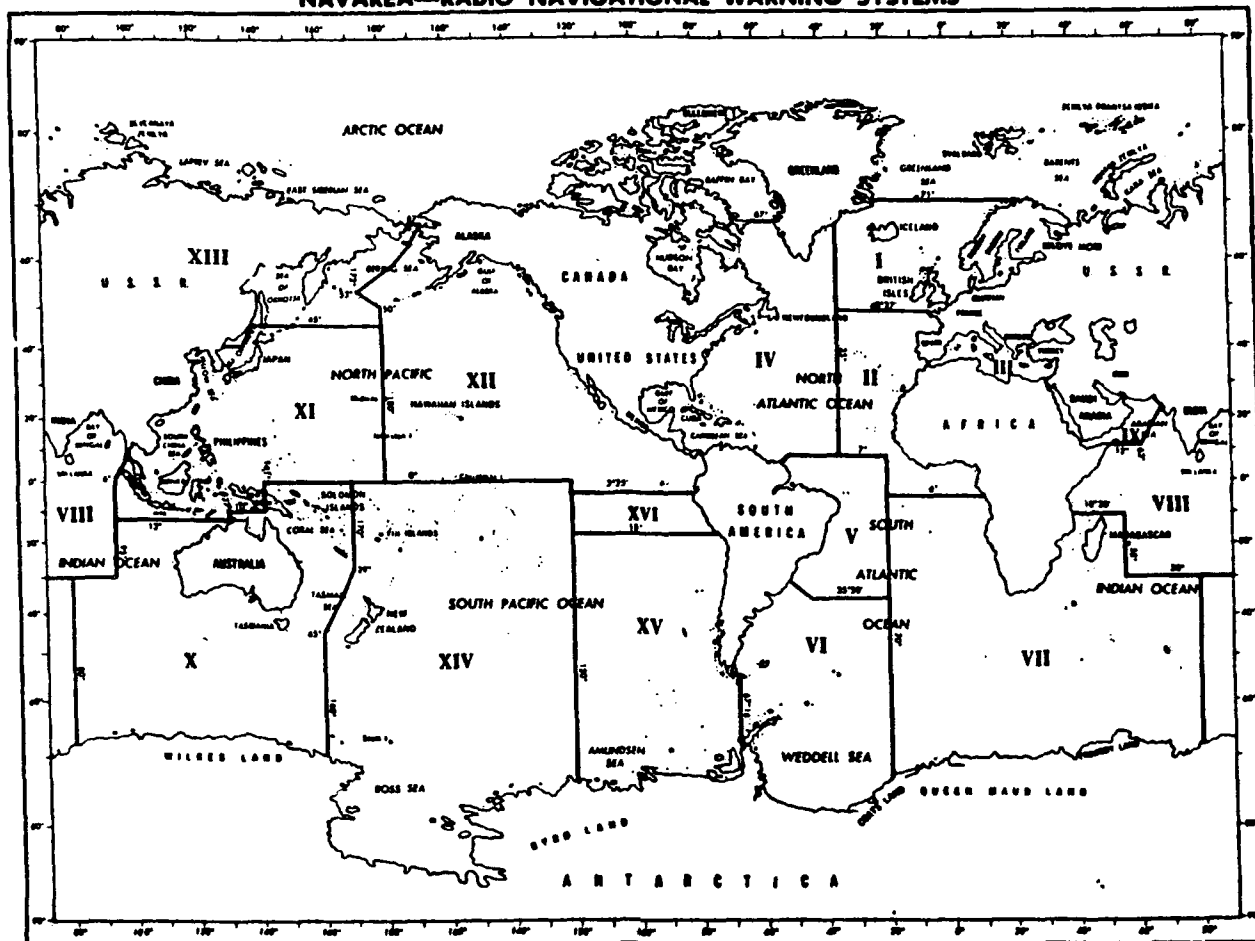


FIGURE 1

# U.S. RADIO NAVIGATIONAL WARNING SYSTEMS

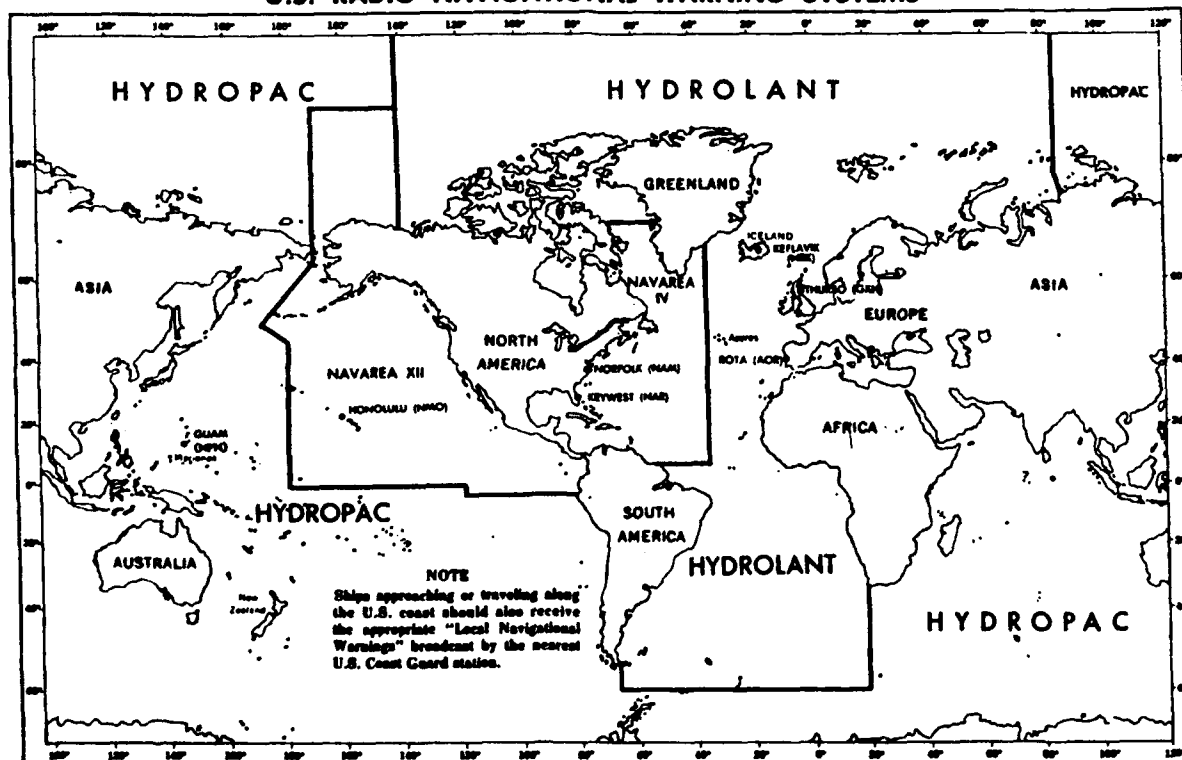


FIGURE 2

time delays. Radio teletype is a considerable improvement over Morse code service, but it has inherent deficiencies. Propagation restrictions during solar activity, frequency allocation requirements, broadcast scheduling, and the need for a skilled, dedicated radio operator are just a few. In addition, promulgation of warnings by medium frequency (MF) and high frequency (HF) radio contributes to circuit loads of these already heavily overburdened radio communications systems. For these reasons, the Navy has moved further along to sophisticated satellite based communications systems.

Initial attempts to bring the commercial shipping community into the world of satellite communications for MSI purposes faced several problems. Foremost among these was cost. Next was the lack of emergency power systems on commercial ships to operate satellite terminals in emergencies. Third was the inability of satellite communications to contact ships in the immediate vicinity when in distress. Finally, the need for a stable satellite antenna in emergency situations had to be met.' The maritime community, under the direction of the IMO, set out to solve these problems. The result of their efforts is the Global Maritime Distress and Safety System (GMDSS).

#### GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM

The Global Maritime Distress and Safety System was adopted in November 1988. This process took many years of development,

study and debate in the IMO.<sup>10</sup> The transition period to full operation is lengthy. It will be formally implemented starting in 1992, although some portions are already operational. Nearly all commercial ships over 300 gross tons must comply with specific radio equipment carriage requirements by 1999 when the system is fully operative. The functions of the GMDSS will provide a new standard of safety for mariners worldwide.

The Global Maritime Distress and Safety System (GMDSS) was developed by the IMO to take advantage of modern communications systems. Its goals are to improve the dissemination and receipt of several types of information.

Distress message processing will undergo fundamental changes. Now it is from ship to ship with a 60% chance of being heard. Soon it will be ship to shore where there is a 99.9% chance of being heard.<sup>11</sup> Satellite communications and automation are the tools of this change.

#### MSI DISSEMINATION AS PART OF THE GMDSS

The MSI subject categories within the GMDSS are expanded considerably to meet modern day requirements of world shipping. Not all the subject areas are of interest to USN combatants, but the new equipment and procedures often permit selective receipt of data. This allows control of not only the subjects received, but also the volume of information to be processed on board. These new developments offer the greatest potential benefit to

the Navy.

There are seven basic categories of MSI within the GMDSS:<sup>12</sup>

- Navigational Warnings
- Meteorological Warnings
- Ice Reports\*
- Search and Rescue Information
- Meteorological Forecasts\*
- Pilotage Service Messages\*
- Electronic Navigation System Messages\*

Navigational warnings include: casualties to lights, fog signals and buoys affecting main shipping lanes; dangerous wrecks; establishment of major new aids to navigation or significant changes to existing ones; the presence of large unwieldy tows; drifting mines; areas where search and rescue (SAR) and antipollution operations are being carried out; notification of ships and aircraft reported in distress, overdue or missing; newly discovered rocks, shoals, reefs and wrecks; unexpected alteration or suspension of established routes; cable or pipelaying activities, the towing of large submerged objects for research or explorational purposes, the employment of manned or unmanned submersibles, or other underwater operations constituting potential dangers; establishment of offshore structures; significant malfunctioning of radio navigation services; informa-

\* These categories marked with an asterisk can be blocked selectively at the receiver; that is, receipt of these types of data is at the user's option.

tion concerning special operations which might affect the safety of shipping, sometimes over wide areas, e.g., naval exercises, missile firings, space missions, nuclear tests, etc.<sup>13</sup>

Weather warnings are advanced notification of severe weather. This includes tropical storms, tsunami alerts, winds of force 10 and above on the Beaufort scale, sub-freezing air temperatures associated with gale force winds causing severe ice accretion on superstructures, etc.<sup>14</sup>

Search and rescue alerts are notification of vessels in distress and requiring assistance.<sup>15</sup>

Under the GMDSS, a ship anywhere in the world will be able to receive all the above types of information practically without delay. Significantly, this can be done by just flipping the "on" switch of two small receivers and making sure the paper is in the printer!

#### COASTAL WARNINGS - NAVTEX

NAVTEX is the choice of the international maritime community as the primary method for disseminating coastal warnings for the twenty first century. These warnings reach about 200 miles off shore. NAVTEX is a receive only terrestrial based radio system that operates primarily on a frequency of 518 kHz<sup>16</sup> as an integral part of the WWNWS under the GMDSS.<sup>17</sup>

NAVTEX uses a universal broadcast format on a single, time shared frequency. This passive system furnishes hard copy to the

watch officer from all selected MSI categories.

The NAVTEX receiver's internal design is such that it rejects messages beyond a certain readable error threshold. It also tracks messages previously received correctly and rejects duplications. Ships can receive data concerning only specified subject categories and areas at their own discretion without shore side filtering. This keeps the amount of extraneous information received to a minimum.<sup>18</sup>

NAVTEX shipboard equipment is extremely inexpensive and simple to operate. The receiver is small enough to be installed in the chart room or even on the bridge of a ship. In this way, the information it records is instantly available to the officer of the deck or watch officer. A typical receiver with an internal printer is 5 inches high, 11 inches wide, and 3 inches deep. It weighs about 3.5 pounds.<sup>19</sup> The antenna used can be as simple as a three foot whip. NAVTEX receivers are available now for less than \$1,000.

NAVTEX data are already available in several high traffic areas of the world. See Tables 1 and 2 for a listing of active and planned NAVTEX stations, respectively.<sup>20</sup>

Should the Navy choose not to carry a simple, inexpensive NAVTEX receiver, it can still receive NAVTEX warnings. The ship's narrow band direct printing receiver can be tuned to 518Khz. The schedules for these broadcasts are published by the DMA.<sup>21</sup> Of course to do that will tie up a radio operator and his

TABLE 1

NAVTEX stations in full or trial operation as of 26 March 1990

<u>United Kingdom</u> Cullercoats Niton Portpatrick	<u>Portugal</u> Lisbon Azores (Horta)	<u>Yugoslavia</u> Split	<u>Sweden</u> Harnosand Stockholm	<u>Hong Kong</u>
<u>Netherlands</u> IJmuiden	<u>USSR</u> Odessa Zhdanov Novorossiisk Murmansk Arkhangelsk Yallin	<u>Egypt</u> Ismailia	<u>Canada</u> Sydney	<u>China</u> Zhenjiang Guangzhou Fuzhou Shanghai Dalian Tianjin
<u>Iceland</u> Reykjavik		<u>Bulgaria</u> Varna	<u>Bermuda</u> St. Georges	<u>Chile</u> Valparaiso Antofagasta Talcahuano Puerto Montt Punta Arenas
<u>Norway</u> Bodo Rogaland Vardoe	<u>Turkey</u> Izmir Samsun Istanbul Antalya	<u>U.S.</u> Boston New Orleans Portsmouth Miami San Juan Long Beach Astoria San Francisco Honolulu Guam	<u>Argentina</u> Bahia Blanca Buenos Aires Comodoro Rivadavia Mar del Plata Rio Gallegos Rosario Ushuaia	
<u>Belgium</u> Oostende	<u>Greece</u> Limas Iraklion Kerkyra			<u>Cyprus</u> Troodos
<u>France</u> Brest				

TABLE 2

NAVTEX stations in planning stages as of 26 March 1990

<u>GermDemocratic Republic</u>	<u>Italy</u> Ancona Augusta Casliari Rome	<u>India</u> Madras Bombay	<u>Japan</u> Otaru Kushiro Yokohama Moji Naha	<u>USSR</u> Vladivostok Malokurilsk Kholmsk Nikolaevsk Ust-Bolsherek Petropavlovsk Nesadan Pakhacha Providencia
<u>France</u> Le Conquet Toulon	<u>Israel</u> Haifa	<u>Egypt</u> Alexandria	<u>Republic of Korea</u>	
<u>Spain</u> Finisterre Canary Islands Tarifa Cabo La Neo	<u>Uruguay</u> Colombia Lasuna del Sauce La Paloma Montevideo Punta del Este Salto	<u>Bahrain</u> Hamala	<u>U.S.</u> Kodiak Adak	
<u>Cameroon</u> Douala		<u>Saudi Arabia</u> Dammam Jeddah		
		<u>Singapore</u> Jurong		

equipment. Furthermore, it will delay getting the incoming information to the watch officer. In addition, the advantage of rejecting duplicate messages as well as the ability to reject unwanted subjects will be lost. Accessing an automated system manually defeats the purpose of NAVTEX.

More than 80% of the present messages transmitted as HYDROLANTs and HYDROPACs are reformatted foreign coastal warnings appropriate for transmission on NAVTEX.<sup>22</sup> Their timely availability to DMAHTC is a direct result of their inclusion in a NAVAREA warning broadcast and the close cooperation existing among NAVAREA coordinators. Once the GMDSS is fully operational, the decentralized NAVTEX broadcast service will reduce by an order of magnitude the warnings available to DMAHTC as NAVAREA messages. With a dependable range of approximately 200 miles, NAVTEX broadcasts will be beyond the capability of the DMA to receive. The decentralization inherent in the NAVTEX system will make conventional retransmission to DMA impractical if not impossible. Obviously, if DMA fails to receive the data, it cannot relay the information to USN communications stations.

Knowing this, it is difficult to imagine a prudent mariner putting to sea without NAVTEX.

#### LONG RANGE WARNINGS - SAFETYNET

Beyond NAVTEX range, or where NAVTEX is not available, most mariners today rely on HF Morse code to receive MSI by radio. A



few ships use NBDP. The Navy is almost totally dependent on the collection efforts of the DMA to furnish it MSI concerning the open sea. SafetyNET is the system of the future for these offshore regions.

The International Maritime Satellite Organization (INMARSAT) defines SafetyNET as "an international automatic direct printing satellite based service for the promulgation of MSI to ships."<sup>23</sup> SafetyNET uses commercial communications satellites operated by INMARSAT. These satellites provide communications coverage to approximately 70 degrees North and South latitude.

There is little commercial shipping in extreme polar regions and even less warning information. If radio warning coverage is required in these areas, either NAVTEX or national HF service is capable of meeting that need. USN ships which operate in the ice laden high latitudes are currently served by their own special communications equipment.

The satellite Enhanced Group Call (EGC) SafetyNET system has proven in tests to be extremely versatile and dependable.<sup>24</sup> It was adopted by the IMO as the primary long range MSI broadcast system for the GMDSS.<sup>25</sup> It also may be used instead of NAVTEX for coastal warnings if a national authority so desires. After 1 August 1993, SafetyNET broadcasts normally will contain only warnings not carried by NAVTEX.

SafetyNET has been designed to operate with a newly created Standard-C satellite communications terminal. In the receive only version, the terminal operates like its coastal broadcast

partner, the NAVTEX receiver. It is compact, simple to operate and inexpensive. It is capable of selecting which categories of messages to receive. Certain classes of "ALL SHIP" messages, such as search and rescue alerts, cannot be deselected<sup>26</sup>. It rejects previously received messages. Since SafetyNET, like NAVTEX, uses a passive receiver, it produces practically no electronic emissions.

The unit is small enough to be installed in the chart room or on the bridge of a ship for ease of access. A typical unit is 3 inches high, 8 1/2 inches wide, 11 inches deep and weighs 4.4 pounds.<sup>27</sup> It connects to practically any standard computer printer. Data are received at 600 bits per second which is twelve times faster than radio teletype and 30 times faster than Morse code. The receiver has an omni-directional antenna that is compatible with a Global Positioning System (GPS) receiver. In fact, a combined GPS/SafetyNET antenna is now on the market. This unit is 10 inches high and 4 inches in diameter. It weighs only 1.1 pounds.<sup>28</sup>

SafetyNET features a major enhancement that distinguishes it from NAVTEX. Satellite communications cover extensive areas of the globe from a single satellite. Therefore, artificial geographic limitations have been programmed into the SafetyNET system. This feature does not, however, affect the passive nature of the receiver's operation. The software in the receiver does the processing independently, based on what it receives from the ground station over the satellite link. The ship's position is

entered periodically into the receiver manually or automatically by the ship's electronic navigation equipment, such as LORAN-C or GPS. This position is compared by the receiver with the incoming signal. If it matches the geographic limit parameters of a transmission, the message is recorded and printed.

The limits of all sixteen NAVAREAS of the WWNWS are programmed. Even though a single satellite footprint may include multiple NAVAREAS, a ship need only copy the messages affecting its area(s) of concern.

The timeliness of the EGC SafetyNET system is a measurable improvement over existing systems. During the EGC Sea Trials of the SafetyNET system, a violent storm swept across southern England. A ship capsized around 1000 hours GMT creating a potential hazard and Dover Harbor was closed until further notice. The Coordinator of NAVAREA I transmitted a warning by SafetyNET. He informed the Coordinator of NAVAREA IV (DMA) by traditional electronic means (AUTODIN). Ships equipped with a SafetyNET receiver had a hard copy of this information in less than two minutes.<sup>29</sup> DMAHTC received the message one hour and twenty-five minutes later.<sup>30</sup> Ships equipped with NAVTEX receivers had the information in one hour and thirty minutes.<sup>31</sup> Allowing time for reprocessing and transmitting the new message to USN communications centers, the earliest a ship using only the HYDROLANT broadcast could learn of this event was 1600Z on scheduled broadcasts from Norfolk, Virginia; Thurso, Scotland; and Rota, Spain.<sup>32</sup> The advantage of less than two minutes versus

more than six hours is obvious.

Estimated cost for civil SafetyNET receivers today is between five and ten thousand dollars. This will no doubt be reduced markedly as mass production takes hold during the 1992-1999 transition period.<sup>39</sup> This does not represent a major per ship cost for the Navy, even in an era of declining budgets. SafetyNET has three more advantages. First is reduced conventional communications circuit time. Second is the 99%+ dependability of data receipt in any weather day or night. Third is the absolutely minimal electronic emissions due to the passive nature of the system.

The compact size of the receiver and its capability to select messages by category and area of operation, represent a unique combination of benefits. Furthermore, the right messages can be received by the watch officer at the right time and in the right place. Finally, there is no need for skilled radio officers or technicians to operate the equipment. Overburdened communications equipment will become available for other message traffic.

The GMDSS, which includes both NAVTEX and SafetyNET, is a cooperative, worldwide development. It is envisioned that all coastal states, either directly or through NAVAREA coordinators, will participate in its operation. A ship equipped with a NAVTEX and a SafetyNET receiver is well protected. It can practically be guaranteed receipt of all coastal and long range warnings from the Worldwide Navigation Warning Service.

During peacetime, non-exercise periods, the combination of SafetyNET and NAVTEX offers the Navy a way to decrease the burden on its military communications system and receive warnings in a more timely manner. If INMARSAT satellites are declared unusable during military exercises or during periods of conflict, present MF and HF systems can be reactivated partially or fully as needed.

### CONCLUSION

The only possibility for timely receipt of navigational warnings by USN ships worldwide is through the broadcast networks based on the GMDSS, i.e., NAVTEX and SafetyNET.

It would be efficient, economical, and prudent for USN ships to carry both NAVTEX and SafetyNET receivers. It would be counterproductive to jury-rig around the GMDSS.

The SafetyNET antenna is compatible with the GPS antenna. Since every Navy ship will eventually be fitted to use GPS, these antennas should be combined.

DMA must participate in the GMDSS if it is to maintain timely access to even a portion of worldwide maritime safety warning information. It remains committed to providing the U.S. Navy with broadcast warnings. It also is committed to providing MSI for NAVAREAS IV and XII using SafetyNET transmissions. It is time for the Navy to consider the advantages and disadvantages of MSI receipt using NAVTEX and SafetyNET based on merit.

Use of the equipment created for the GMDSS will result in the receipt of more timely and comprehensive MSI. It enhances safety at sea. It need not be expensive. It need not compromise a ship's location. The system has been tested and it passed with flying colors. NAVTEX is here now. SafetyNET will be here in 1992. It is not too soon to act.

#### RECOMMENDATION

The U.S. Navy should equip its ships with NAVTEX and SafetyNET equipment. All surface units should be fitted with NAVTEX no later than 1 August 1993. All surface units that operate more than 200 miles from the coast should be fitted with SafetyNET satellite communications receivers no later than 1 February 1999. The cost of one major casualty related to the lack of warning information over the next decade will more than offset the minor equipment investment required to receive the information that can prevent that accident.

## ACRONYMS

DMA	United States Defense Mapping Agency
DMAHC	Defense Mapping Agency Hydrographic Center
DMAHTC	Defense Mapping Agency Hydrographic/Topographic Center
DoD	United States Department of Defense
DoS	United States Department of State
EGC	Enhanced Group Call
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
HF	High frequency radio
HYDROLANT	Hydrographic warning - Atlantic Ocean
HYDROPAC	Hydrographic warning - Pacific or Indian Ocean
IHO	International Hydrographic Organization
IMO	International Maritime Organization
INMARSAT	International Maritime Satellite Organization
MF	Medium frequency radio
MSI	Maritime Safety Information
NAVAREA	Radio Navigational Warning Area
NAVTEX	Navigational Telex
NBDP	Narrow Band Direct Printing
SafetyNET	Long range MSI by EGC using INMARSAT satellites
SAR	Search and Rescue
USCG	United States Coast Guard
USN	United States Navy
USNOO	United States Naval Oceanographic Office
WWNWS	Worldwide Navigational Warning Service

## ENDNOTES

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